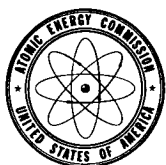


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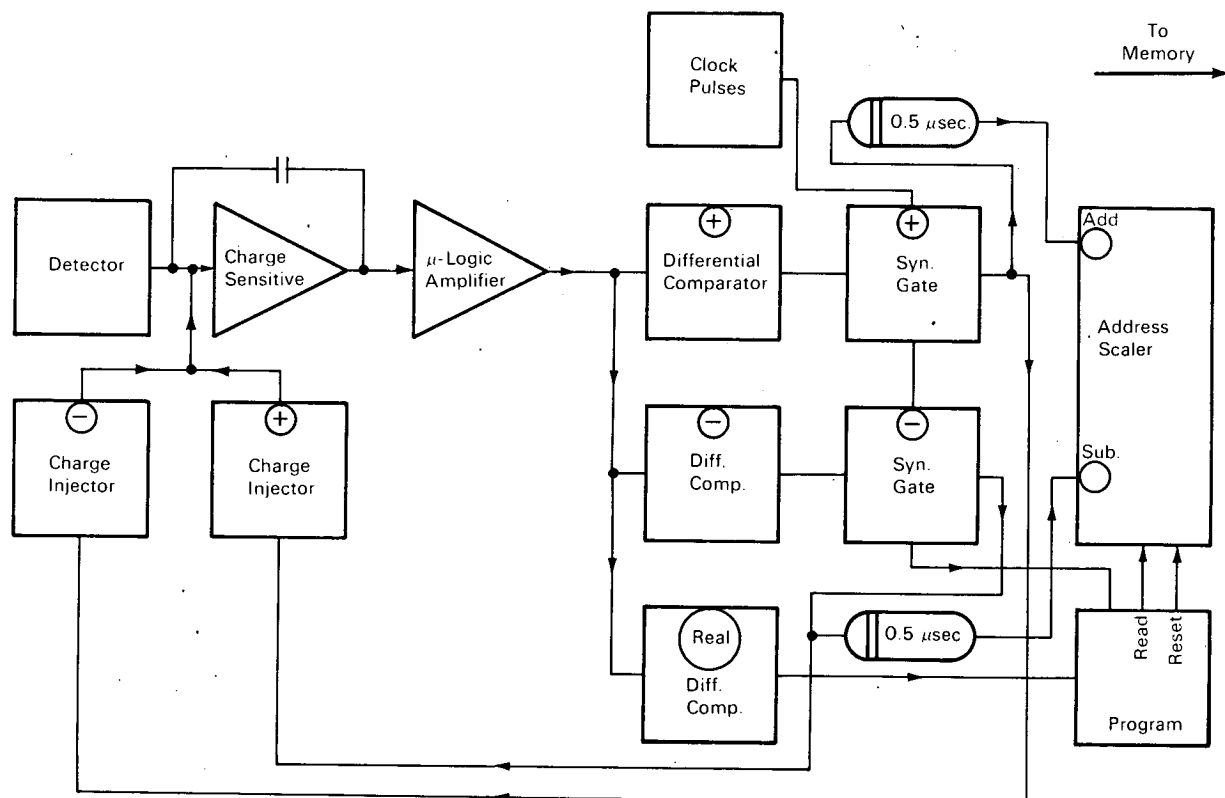


AEC-NASA TECH BRIEF



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Pulse-Height Analyzer with Digital Readout



The problem:

To devise an electronic circuit for measurement of the amplitude of electric pulses from nuclear-radiation detectors. Conventionally a pulse is passed through linear amplifiers and applied to a pulse-height detector, and the result is converted to digital form for storage.

The solution:

A feedback-controlled pulse-amplitude integrator and amplifier used as an analog-to-digital converter

that converts event-liberated charges, emanating from a nuclear-particle detector, directly to numbers rather than to analog-dependent voltages.

In this circuit a pulse is amplified in an amplifier that need not be linear, and the amplitude is immediately read in digital form. The amplifier is arranged as an integrating circuit. When an input pulse is received and integrated, a series of discrete feedback signals are applied to the amplifier input to return the input potential to zero. The required number of such feed-

(continued overleaf)

back signals is counted and read out as a digital indication of pulse amplitude. This technique simplifies the circuit overall, improves overload performance, and lessens dependence on amplifier-circuit stability.

How it's done:

For direct analog-to-numerical conversion, an amplifier (see figure), employing an integrating first stage, is employed as a null amplifier to control the flow rate of input-recharge pulses necessary to reestablish an original input balance. The number of these recharge impulses needed is summed in an address scaler and later transferred into a memory as a number.

Nuclear-event-induced input charges collected at the output of a detector are converted to numbers by metering of the amount of charge necessary for complete restoration of the input charge to its original state. This requires only a null-seeking system with metered restitution.

An input-integrator circuit provides an output voltage proportional to the differential accumulated charge, and a moderate-gain direct-coupled amplifier further amplifies the integrator-output voltage to a level sufficient to drive the positive-negative level-sensing differential comparators. These comparators, which sense imbalance conditions of the amplifier's output, provide demand for metered charge nulling of the input integrator at an injection rate determined by a local clock.

Whenever the null amplifier produces an output voltage, the differential comparators sense the polarity or intensity of imbalance. Two of these comparators sense small (+) and (-) amplifier-output base-line shifts, while the third senses a level high enough to indicate the presence of a real event. The (+) and (-) comparators are triggered as the output base line moves either positively or negatively to produce a demand for continual nulling of the amplifier's base line.

The true numerical value transferred into the memory is the difference between the number of impulses originating from the (+) and (-) injectors during the sampling interval. This provides for true signal-averaging over a fixed time period (integration), and allows for accurate assessment of the true zero. In between occurrences of events, the (+) and (-) comparators supply a metered feedback stabilization for the null-seeking system by subtracting or adding charge to the integrator's input on demand, in order to maintain a zero amplifier-output voltage balance (differentiation).

Notes:

1. This information may interest designers of nuclear-instrumentation or computer systems.
2. Inquiries concerning this innovation may be directed to:

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Reference: B69-10640

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Patent status:

Inquiries concerning rights for commercial use of this innovation may be addressed to:

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